

CLAIMS

1. An extruded polymeric tubing segment, the tubing segment comprising at least two regions along the length thereof, wherein a first of said regions and a second of said regions have different longitudinal extruded orientations relative to each other.

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2. An extruded polymeric tubing segment as in claim 1 wherein the tubing segment is a catheter shaft having proximal and distal regions, the shaft having a higher longitudinal orientation in the proximal region relative to the orientation of the shaft in the distal region.

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3. An extruded polymeric tubing segment as in claim 1 wherein the tubing segment is a parison for a catheter balloon.

4. An extruded polymeric tubing segment as in claim 3 wherein the tubing segment comprises said first and second regions and at least a third region along the length thereof, the third region having a different longitudinal extruded orientation relative to at least the second region.

5. An extruded polymeric tubing segment as in claim 4 wherein the second region has a higher or lower longitudinal orientation relative to the first and third regions.

6. An extruded polymeric tubing segment as in claim 1 wherein the tubing material is a single polymer.

25 7. An extruded polymeric tubing segment as in claim 1 wherein the tubing is a coextruded laminate of at least two different polymers.

8. An extruded polymeric tubing segment as in claim 1 wherein the tubing material comprises a polymer blend.

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9. An extruded polymeric tubing segment as in claim 1 wherein said first and second regions have different wall thicknesses relative to each other.

10. A method of forming a polymeric tubing segment for a medical device comprising extruding a tube of polymer material through a die and cooling the extruded tubing by drawing it through a cooling region spaced at a gap length from the die to the

5 cooling bath, wherein the drawing rate, or the gap length, or the cooling rate of the cooling region, or any combination thereof, is altered at least once along the length of the segment, whereby the segment is formed with at least two regions along the length thereof, a first of said regions and a second of said regions having different longitudinal extruded orientations relative to each other.

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11. A method as in claim 10 further comprising the step of cutting the tubing segment from the extruded tube in a manner such that said regions occur at predetermined locations along the length of the tubing.

15 12. A method as in claim 10 wherein a plurality of said tubing segments are formed in the extruded and drawn tube, said drawing rate or gap length or cooling rate or combination thereof, being varied between at least two different value sets along the length of each said tubing segment.

20 13. A method as in claim 10 wherein the gap length is altered along the length of the segment.

14. A method as in claim 10 wherein the tubing segment is a catheter shaft having proximal and distal regions, the shaft having a higher longitudinal orientation in

25 the proximal region relative to the orientation of the shaft in the distal region.

15. A method as in claim 10 wherein the tubing segment is a parison for a catheter balloon.

30 16. A method as in claim 15 wherein the drawing rate, or the gap length, or the cooling rate of the cooling region, or combination thereof, is altered at least a second time along the length of the segment whereby the segment is formed with at least a third

region along the length thereof, the third region having a different longitudinal extruded orientation relative to at least the second region.

17. A method as in claim 16 wherein the alterations of the drawing rate, or the gap length, or the cooling rate of the cooling region, or combination thereof, is altered to provide the first, second and third regions in sequential order with the second region having a higher or lower longitudinal orientation relative to both the first and third regions.
- 10 18. A method as in claim 10 wherein the tubing material is a single polymer.
19. A method as in claim 10 wherein the tubing is coextruded as a laminate of at least two different polymers.
- 15 20. A method as in claim 10 wherein the tubing material comprises a polymer blend.
21. A method as in claim 10 wherein the wall thickness of the tubing segment is varied over the length thereof.
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22. A method as in claim 21 wherein the wall thickness is varied concurrently with the variation in longitudinal orientation in said at least two regions.
- 25 23. A method of making a parison for forming a medical device balloon in which portions of the parison are slated to form cone and waist portions of the balloon and a portion is slated to form the balloon body, the method comprising a step of extruding polymeric material to form the tube, wherein the extruding step is controlled to provide the extruded tube with a varying longitudinal orientation, the variation providing a lower or higher orientation for the cone and waist slated portions of the parison relative to the portion slated to form the balloon body.
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24. A method as in claim 23 wherein the extruding step is controlled to provide the portion slanted to form the body with a higher relative longitudinal orientation, the portions slanted to form the waists of the balloon with a lower relative longitudinal orientation and the portions slanted to form the cones of the balloon with a varying longitudinal orientation ranging between the higher and the lower relative orientations.

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25. A method as in claim 23 wherein the extruding step is controlled to provide the extruded tube with a varying wall thickness, the variation providing a lower wall thickness for the cone and waist slanted portions of the parison relative to the portion slanted to form the balloon body.

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26. A method of forming a polymeric tubing segment for a medical device comprising extruding a tube of polymeric material through a die and cooling the extruded tubing by drawing it through a cooling region spaced at a gap length from the die to the cooling bath, wherein the drawing rate, or the gap length, or the cooling rate of the cooling region, or any combination thereof, is altered along the length of the segment, whereby the segment is formed with at least two regions along the length thereof, a first of said regions and a second of said regions having different elongation at 15 break properties relative to each other.

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27. A method as in claim 26 wherein the drawing rate, or the gap length, or the cooling rate of the cooling region, or combination thereof, is altered to provide one of said regions with a elongation at break which is at least 20% below the elongation at 25 break of another of said regions.

28. A method as in claim 26 wherein the drawing rate, or the gap length, or the cooling rate of the cooling region, or combination thereof, is altered to provide one of said regions with a elongation at break which is 30% below the elongation at break of 30 another of said regions.

29. A method as in claim 26 wherein the gap length is altered along the length of the segment.

30. A method as in claim 26 wherein the wall thickness of the tubing segment is varied over the length thereof.

31. A method as in claim 30 wherein the tube is extruded through a die gap and the wall thickness is varied by varying the die gap.

10 32. A method as in claim 31 wherein the wall thickness of the tubing segment is varied concurrently with the variation in longitudinal orientation in said at least two regions.

15 33. A method as in claim 26 wherein the polymeric material comprises a polyamide/polyether/polyester, a polyester/polyether block copolymer, a polyurethane block copolymer or a mixture thereof.

20 34. A method as in claim 26 wherein the polymeric material is a polyamide/polyether/polyester.

35. A method as in claim 26 wherein the extruded tube is formed with a single layer of polymeric material.

25 36. A method as in claim 26 wherein the extruded tube is formed with a plurality of layers of polymeric material.

37. A method as in claim 26 wherein the polymeric material comprises at least two different polymers.

30 38. An apparatus for cooling an elongated extrudate of thermoplastic material emerging from a die, the apparatus comprising a tubular form of high thermal conductivity material having an inner wall sized to surround a length of the extrudate

leaving a coolant gap therebetween, and a coolant inlet providing access for a coolant fluid to be injected into the coolant gap.

39. An apparatus as in claim 38 wherein the tubular form is made of silver.

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40. An apparatus as in claim 38 further comprising a mechanism to move the tubular form of high thermal conductivity material axially toward and away from the die as extrudate is emerging from the die.

10 41. An apparatus as in claim 38 having a plurality of coolant sources associated with the coolant inlet whereby the coolant composition may be changed as extrudate is emerging from the die.

42. An apparatus as in claim 41 wherein said coolant sources include at least
15 one source of hydrogen, helium, air and/or water.